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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,317	02/09/2004	Fusazumi Masaka	026035-00010	6655

7590 04/19/2007
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EXAMINER

LEWIS, BEN

ART UNIT	PAPER NUMBER
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1745

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/19/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/773,317	MASAKA ET AL.	
	Examiner	Art Unit	
	Ben Lewis	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4-6 and 8-15 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4-6 and 8-15 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. ____. |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date ____. | 6) <input type="checkbox"/> Other: ____. |

DETAILED ACTION

Detailed Action

1. The Applicant's amendment filed January 19th, 2007 was received. Claims 1, 2, 5, 9, 11 were amended. Claims 12-15 were added. Claims 3 and 7 were cancelled.
2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action (issued on October 19th, 2006).

Claim Rejections - 35 USC § 112

3. The claim rejections under 35 U.S.C. 112, second paragraph, on claims 1-11 are withdrawn, because the claims have been amended.

Claim Rejections - 35 USC § 103

4. Claims 1-2, 4-5, 9-12, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nanaumi et al. (U.S. Pub. No. 2002/0155340 A1) and further in view of Sompalli et al (U.S. Patent No. 6,524,736).

With respect to claims 1, 11 and 12, Nanumi et al. disclose a membrane electrode assembly (title) wherein, a solution of a sulfonated hydrocarbon polymer in an organic solvent is formed into a membrane having a thickness corresponding to a dry thickness of 20-60 μm by a solution-casting method, etc. The preferred organic solvents are N-methyl pyrrolidone, dimethyl sulfoxide, dimethyl acetamide, etc. (Paragraph 0076). In the formation of the electrode catalytic layer on the polymer electrolyte membrane, the concentration of an organic solvent remaining in the polymer electrolyte membrane should be 5-20 weight %. The more preferred amount of the remaining organic solvent is 5-15 weight % ^(paragraph 77). Accordingly, a solution of a polymer electrolyte in an organic solvent is applied to the catalytic layer of one electrode, and when the concentration of the organic solvent remaining in the polymer electrolyte membrane becomes 5-20 weight %, the catalyst slurry for the other electrode is applied to a surface of the membrane, followed by bonding a gas-diffusion layer for the other electrode thereto (Paragraph 0070). Nanumi et al. does not specifically teach wherein a second solvent for the electrolyte membrane is applied to at least one of facing surfaces of the opposed electrode substrate. However, Sompalli et al. teach methods of preparing membrane electrode assemblies wherein in the pretreatment approach, a porous support substrate is coated with a wetting solvent such that the solvent is imbibed into the pores. A slurry is formed including an ionically conductive material, a catalyst supported on an electrically conductive material, and a solvent that is non-wetting to the porous substrate. The slurry is well mixed and applied as a layer to the surface of the porous support substrate and dried to form a film. The film is applied to a membrane, and heat

Art Unit: 1745

and pressure are applied to form a membrane electrode assembly. Advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the coating of the electrode substrate with a second solvent of Sompalli et al into the MEA fabrication process of Nanumi et al. because Sompalli et al teach that advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67).

Regarding the second solvent being applied in an amount of from $0.001\text{mg}/\text{cm}^2$ to $10\text{mg}/\text{cm}^2$. The disclosure Nanumi et al. as modified by Sompalli et al differs from Applicant's claims in that Nanumi et al. as modified by Sompalli et al do not disclose disclose any coating weight per unit area data of the solvent. However, Sompalli et al. recognize the need to control the amount of solvent used in the coating process since Sompalli et al teach that controlling the content of non-wetting solvent in the slurry is very important as it determines the rate of drying of the catalyst layer and the degree of intrusion, and subsequent loss, of Nafion into the porous support. As a result, the non-wetting solvent content affects the structural integrity of the catalyst layer, and the Nafion content in the electrode. High non-wetting solvent content leads to mud-cracking of the catalyst layer due to non-uniform drying, and seriously compromises its robustness. Low non-wetting solvent content leads to increased seepage of Nafion into the support, and too great a loss of Nafion reduces structural support as the Nafion

Art Unit: 1745

provides the bond holding the catalyst and catalyst support together with the ionomer (Col 9 lines 30-45). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to control the amount of solvent used in the coating of membrane of Nanumi et al. as modified by Sompalli et al. to within the range as claimed by Applicant because Sompalli et al recognizes the need to control the amount of solvent used in the coating process. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art. In re Boesch*, CCPA 1980, 617 F.2d 272, 205 USPQ215.

With respect to claim 2, 9, Sompalli et al. teach methods of preparing membrane electrode assemblies wherein in the pretreatment approach, a porous support substrate is coated with a wetting solvent such that the solvent is imbibed into the pores. A slurry is formed including an ionically conductive material, a catalyst supported on an electrically conductive material, and a solvent that is non-wetting to the porous substrate. The slurry is well mixed and applied as a layer to the surface of the porous support substrate and dried to form a film. The film is applied to a membrane, and heat and pressure are applied to form a membrane electrode assembly. Advantageously, this method controls the drying to form a more robust electrode by preventing electrode shrinkage and subsequent cracking of the electrodes (Col 1 lines 45-67).

With respect to claims 4, 5 and 15, Nanumi et al. disclose a membrane electrode assembly (title) wherein, a solution of a sulfonated hydrocarbon polymer in an organic solvent is formed into a membrane having a thickness corresponding to a dry thickness of 20-60 μm by a solution-casting method, etc. The preferred organic solvents are N-methyl pyrrolidone, dimethyl sulfoxide (aprotic dipolar), dimethyl acetamide, etc. (Paragraph 0076). The polymer electrolyte membrane of the present invention is made of a proton (ion) exchange resin, which may be not only sulfonated perfluorocarbon, but also a sulfonated hydrocarbon polymer such as sulfonated polyetheretherketone (PEEK), sulfonated phenoxybenzophenone-benzophenone copolymer "sulfonated aromatic polymer" etc. (Paragraph 0035).

With respect to claim 10, Nanumi et al. teach the hot-pressing conditions are in general preferably a temperature of 60-200 $^{\circ}\text{C}$ and a pressure of 1-10 MPa for 1-5 minutes (Paragraph 0080).

With respect to claim 14, Nanaumi et al. as modified by Sompalli et al. teach that the preferred organic solvents are N-methyl pyrrolidone, dimethyl sulfoxide (aprotic dipolar), dimethyl acetamide, etc. (Paragraph 0076). The instant specification recites that suitable aprotic dipolar solvents include, dimethylsulfoxide, 46.68 "dielectric constant" (Paragraph 0122). Nanaumi et al. as modified by Sompalli et al. do not

Art Unit: 1745

disclose any dielectric constant data of 20 or more. However, it is the position of the examiner that such properties are inherent, given that Nanaumi et al. as modified by Sompalli et al. and the present application utilize the same organic solvent. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. In re Robertson, 49 USPQ2d 1949 (1999).

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nanaumi et al. (U.S. Pub. No. 2002/0155340 A1) in view of Sompalli et al (U.S. Patent No. 6,524,736) as applied to claim 4 above and further in view of Yamakawa et al. (U.S. Pub. No. 2003/0173547 A1).

With respect to claim 6, Nanaumi et al. as modified by Sompalli et al. disclose a membrane electrode assembly in paragraph 4 above. Nanaumi et al. as modified by Sompalli et al. do not specifically teach that the sulfonated aromatic polymer is a sulfonated aromatic polymer. However Yamakawa et al. disclose a halogenated aromatic compound, (co) polymer thereof, and proton-conductive membrane comprising the same (title) wherein the proton-conductive membrane comprising the sulfonated polyarylene (co)polymer according to the invention can realize a proton conductivity equal to that conventionally sulfonated (co)polymers even at a low sulfonic acid group equivalent. Consequently, it is possible to inhibit a reduction of physical properties (such as hot water resistance, toughness, and oxidation resistance) caused by the

Art Unit: 1745

usual sulfonation (Paragraph 0176). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the sulfonated polyarylene polymer of Yamakawa et al. in to the MEA of Nanaumi et al. as modified by Sompalli et al. because Yamakawa et al. teach that the proton-conductive membrane comprising the sulfonated polyarylene (co)polymer according to the invention can realize a proton conductivity equal to that conventionally sulfonated (co)polymers even at a low sulfonic acid group equivalent. Consequently, it is possible to inhibit a reduction of physical properties (such as hot water resistance, toughness, and oxidation resistance) caused by the usual sulfonation (Paragraph 0176).

6. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nanaumi et al. (U.S. Pub. No. 2002/0155340 A1) in view of Sompalli et al (U.S. Patent No. 6,524,736) and further in view of Sansone et al. (U.S. Patent No. 6,187,231 B1)

With respect to claim 8, Nanaumi et al. as modified by Sompalli et al. disclose a membrane electrode assembly in paragraph 4 above. Nanaumi et al. as modified by Sompalli et al. do not specifically teach that the residual solvent in the wet film is reduced by soaking the wet film in water. However Sansone et al. disclose a process for producing polymeric films for use as fuel cells (title) wherein after soaking in one of the above-discussed coagulation baths, the resulting membrane is submerged into a non-solvent bath, such as a water or methanol, or a bath formed of a mixture of non-solvents to remove any residual solvent for about 0.5 to about 60 minutes, usually less

Art Unit: 1745

than about 5 minutes (Col 4 lines 1-10). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the soaking of membrane in water of Sansone et al. in to the MEA fabrication process of Nanumi et al. as modified by Sompalli et al. because Sansone et al. uses water to remove excess solvent.

7. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nanaumi et al. (U.S. Pub. No. 2002/0155340 A1) in view of Sompalli et al (U.S. Patent No. 6,524,736) and further in view of Sansone et al. (U.S. Patent No. 6,187,231 B1)

With respect to claim 13, Nanaumi et al. as modified by Sompalli et al. disclose a membrane electrode assembly in paragraph 4 above. Nanaumi et al. as modified by Sompalli et al. do not specifically teach that the residual solvent in the wet film is reduced by soaking the wet film in water. However Sansone et al. disclose a process for producing polymeric films for use as fuel cells (title) wherein after soaking in one of the above-discussed coagulation baths, the resulting membrane is submerged into a non-solvent bath, such as a water or methanol, or a bath formed of a mixture of non-solvents to remove any residual solvent for about 0.5 to about 60 minutes, usually less than about 5 minutes (Col 4 lines 1-10). Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate the soaking of membrane in water of Sansone et al. in to the MEA fabrication process of Nanumi et al. as modified by Sompalli et al. because Sansone et al. uses water to remove excess solvent.

Response to Arguments

8. Applicant's arguments filed on January 19th, 2007 have been fully considered but they are not persuasive.

Applicant's principal arguments are

(a) Bonsel et al. does not disclose the amount of residual solvent contained in the membrane, nor does it teach limiting the amount of solvent utilized in order to avoid swelling. Bonsel et al. also does not disclose that the ion-conductive membrane contains a limited amount of solvent in an amount of 5 parts by weight or less (claim 1).

In response to Applicant's arguments, please consider the following comments.

(a) Applicant's arguments with respect to claim 1 has been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

Art Unit: 1745

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben Lewis whose telephone number is 571-272-6481.

The examiner can normally be reached on 8:30am - 5:30pm.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1745

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Ben Lewis

Patent Examiner
Art Unit 1745


SUSY TSANG-FOSTER
PRIMARY EXAMINER